

# Toward Low Carbon Fuels

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# LCFS Vision

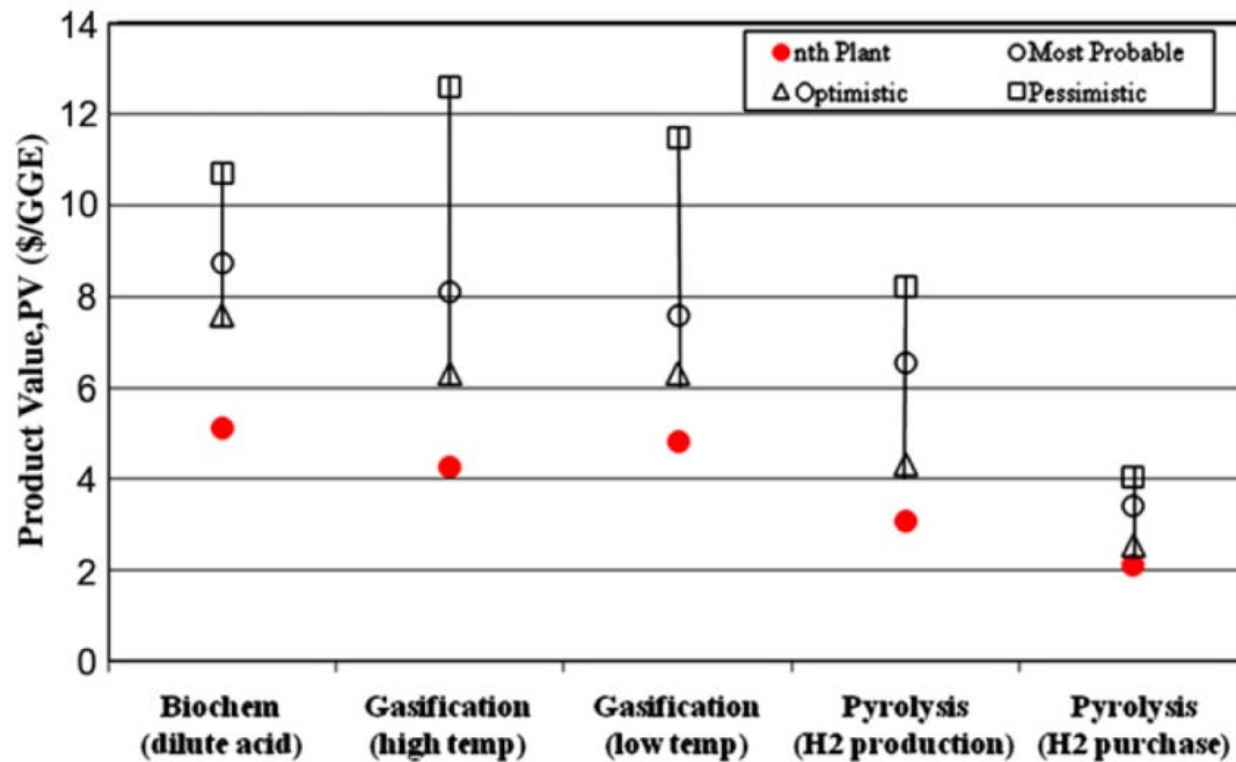
(unchanged since its inception in 2007)

→ Stimulate innovation in new low-carbon energy systems (from biofuels to EVs)!

(based on premise that humans are incredibly creative when we focus our resources and efforts)

LCFS is already a huge success!!! It has already changed industry behavior. It is inspiring a storm of innovation—from oil sands to efficient oilfields to processing entire corn plant

# Biofuels From Pioneer Plants Cost 1.5-3 times an $n^{\text{th}}$ -of-a-kind Biorefinery



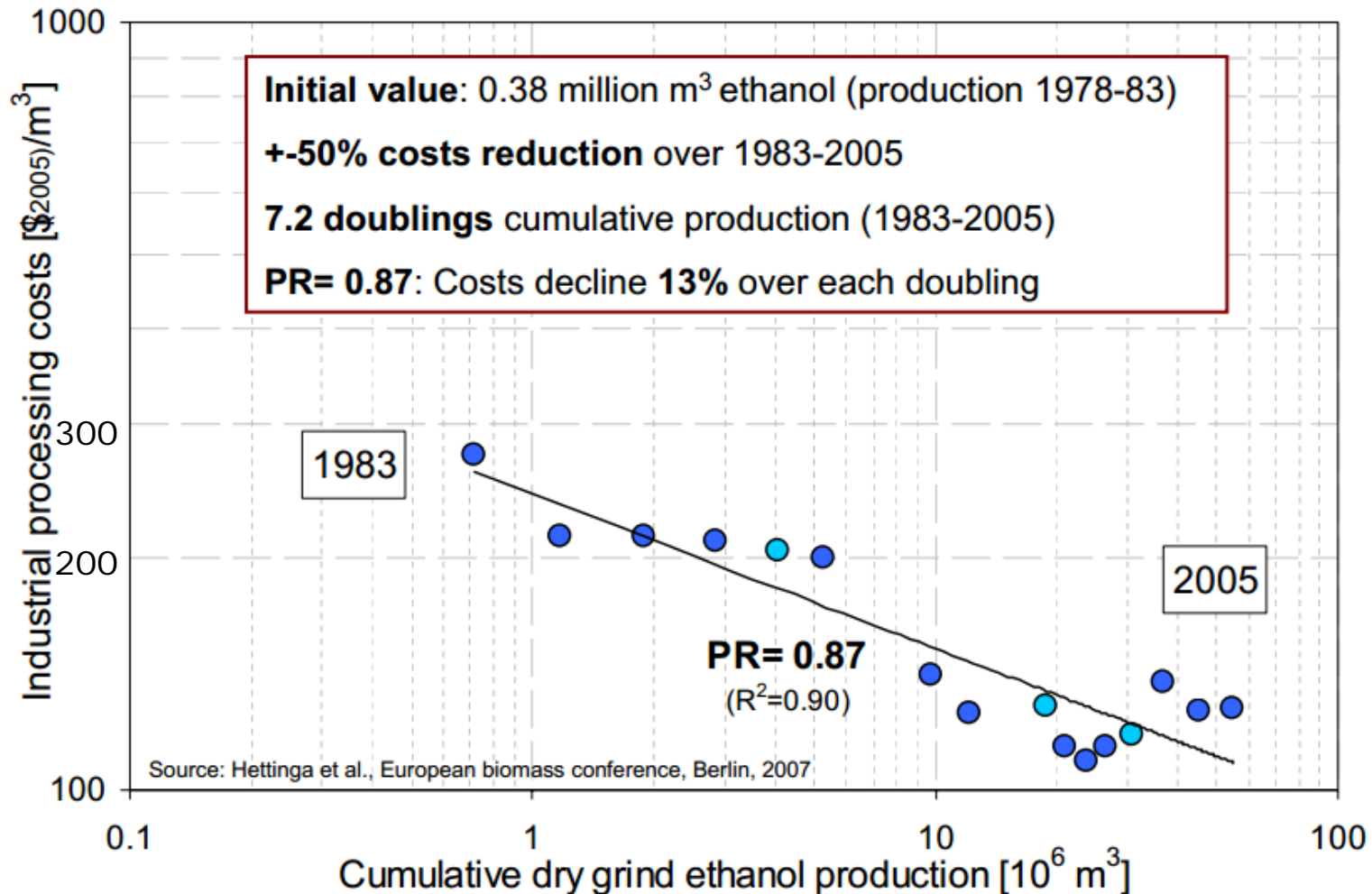
**Fig. 2.** Estimates of product value for pioneer plants are significantly greater than  $n^{\text{th}}$  plant values.

*AnexRP et al. Techno-economic comparison of biomass-to-transportation fuels via pyrolysis, gasification, and biochemical pathways. Fuel (2010)*

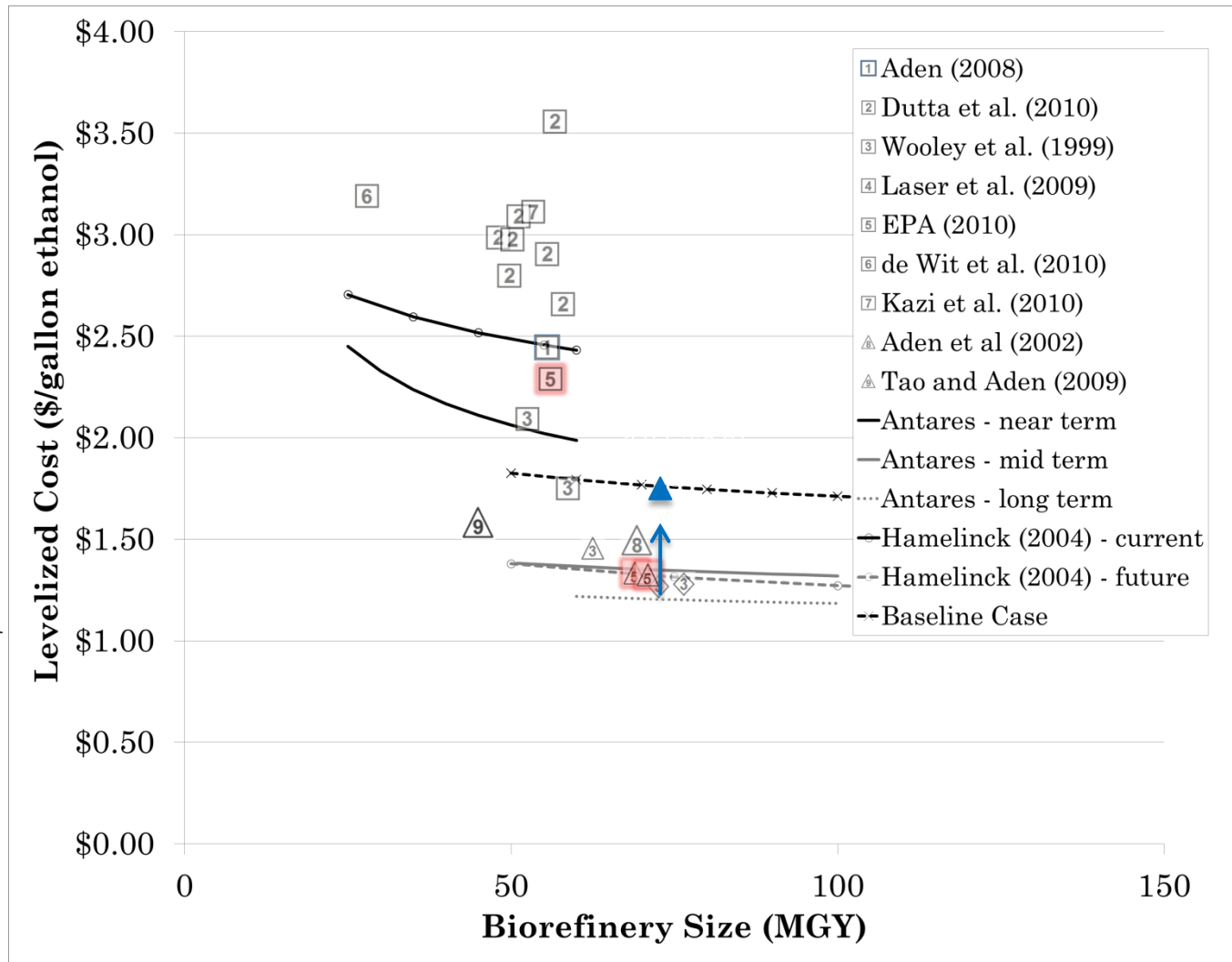
# Corn Ethanol Example: Costs Dropped Over 50% from 1983-2005

(similar for Brazilian ethanol from sugar cane)

## Experience curve: ethanol processing costs



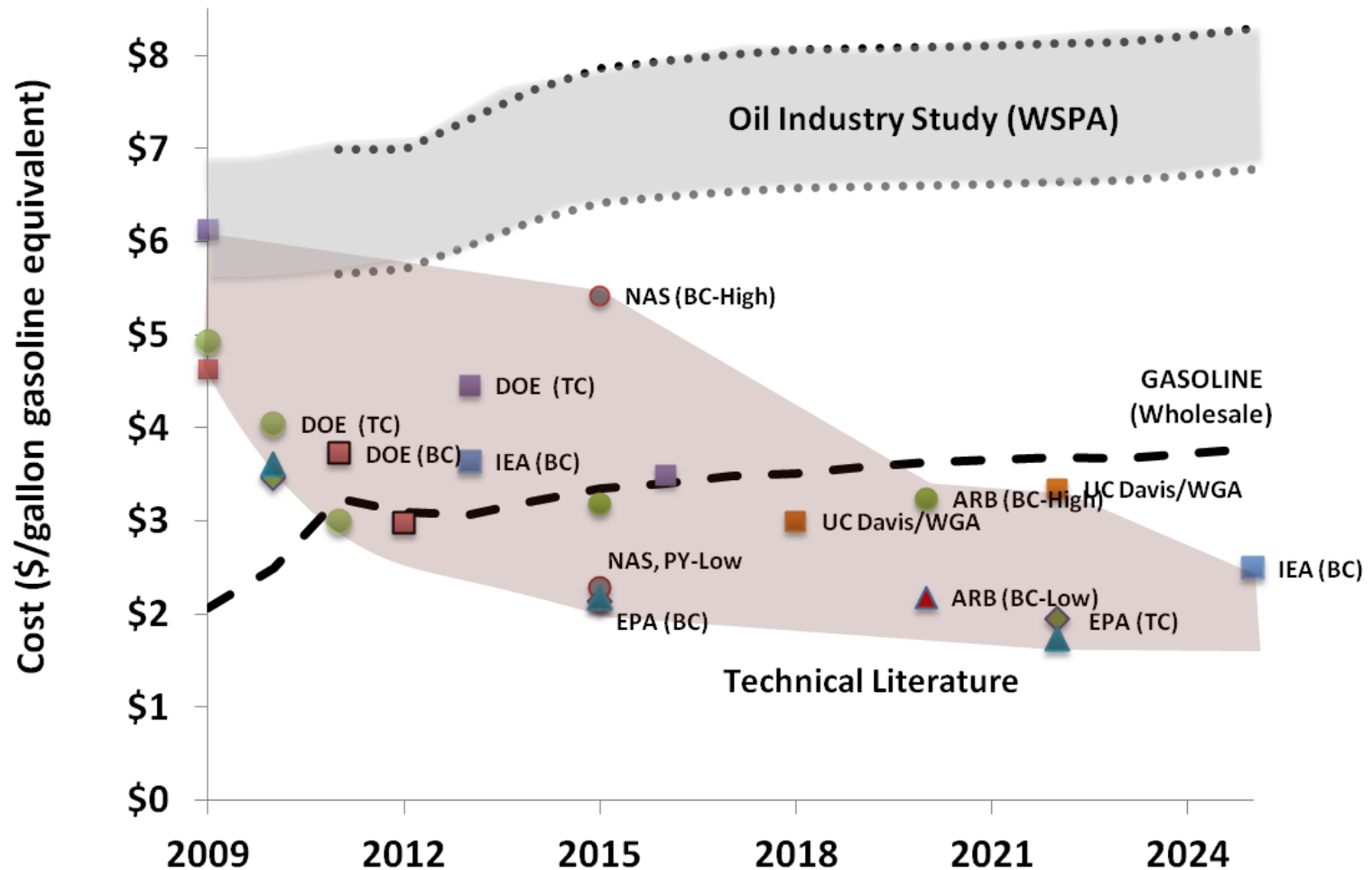
# Cellulosic Biofuel Costs Will Drop Significantly



- Current
- △ Mid-term
- ◇ Long-term

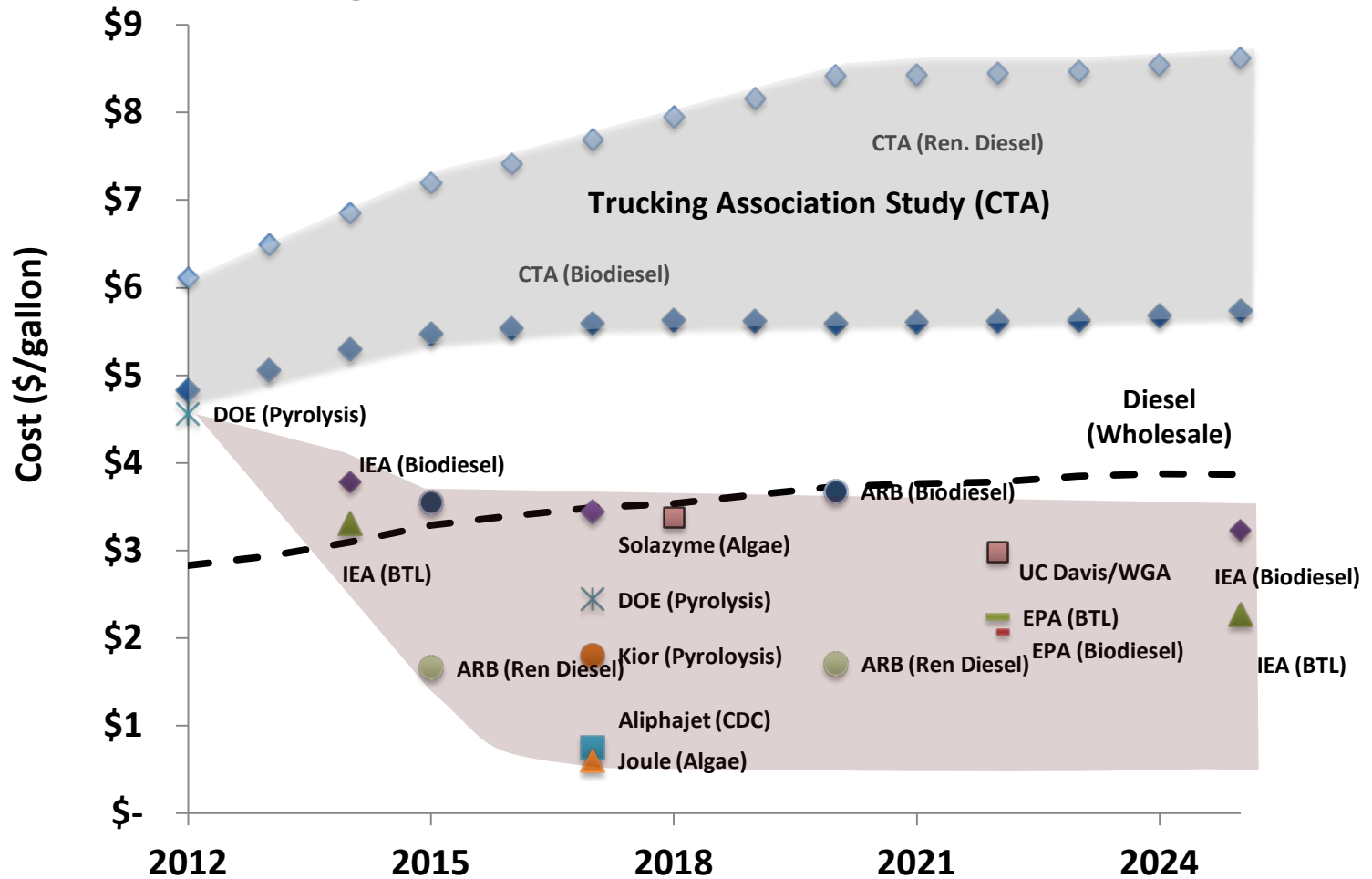
Nathan Parker, ITS-Davis, UC Davis, 2012

# WSPA/BCG Cost Estimates for Biofuels (etoh/bio-gasoline) Are Much Higher Than Others



Graph assembled by Yang Ruan, UC Berkeley Goldman School of Public Policy, 2012

# CTA Cost Estimates for Bio-Diesel Are Much Higher Than All Others



Graph assembled by Yang Ruan, UC Berkeley Goldman School of Public Policy, 2012

# BCG Study Makes Good Point About Interactive Effect of Policies, BUT It Looks Backward, Not Forward

- Assumes NO cellulosic or second generation fuels (without analysis) – the entire purpose of the program.
- Assumes very few plug-in and natural gas vehicles, (without analysis).
- Estimates enormously high costs by assuming that refineries have no way to comply except to stop selling gasoline (to reduce req't for alt fuels).
- Assumes shuffling will lead to increases in global emissions (without analysis) even though transport of fuels accounts for only 1-3% of total lifecycle emissions (and thus is very small effect)



# How to Introduce Alternatives When Initial Costs Are High??

- Carbon pricing
  - Need very high carbon prices to overcome startup barriers and market failures/conditions...which is politically unacceptable at this time
- Biofuel mandate
  - Gov't is poor at picking winners (and losers)
- Gov't subsidies (loan guarantees, tax benefits)
  - Effective if based on technology-neutral performance stds
  - Politically acceptable?
- Performance stds, w/credit trading to harness market forces (LCFS)
  - Pros: technology neutral, does not rely on gov't to pick winners, no cost to taxpayer (but some cost to consumers)
  - Cons: “shuffling”, risk of high prices initially

**→ but this can be solved with a cap on credit prices (which CARB is in process of designing)**

## 3 Principal GHG Emitters

# Oil, Auto, and Electric Utility Industries

1. Auto industry supports regulations to reduce carbon emissions by 50% by 2025 (and investing tens of billions of dollars to do so)
2. Electric utilities increasing renewables to 33% by 2020
3. Oil industry resisting LCFS, Cap&Trade, and Clean Fuel Outlets, and making minimal investment in low-carbon fuels

## And so...

- Given that WSPA and all major oil companies agree that carbon emissions must be reduced,
- Given that hundreds of companies are on the verge of investing in commercial low-carbon (cellulosic) biofuel , but need regulatory certainty...
- What action should California be taking? There are real issues:
  - Important for California to remain committed to strong goals; otherwise investments will not be made
  - LCFS seems best policy approach, but it can be improved.
  - ***Need to maintain regulatory certainty to stimulate innovation, while acknowledging challenges for low-carbon energy***  
(as the BMW person said this morning, CARB is flexible, transparent and engaged)
- I am proud to be Californian!

# List of Studies

- Antares Group Inc (2008). Strategic Assessment of Bioenergy Development in the West: Bioenergy Conversion Technology Characteristics. Western Governors' Association
- DOE, Office of the Biomass Program (OBP), Multi-Year Program Plan, April 2011. OBP, U.S. Department of Energy, Washington, DC, 2011.  
[http://www1.eere.energy.gov/biomass/pdfs/mypp\\_april\\_2011.pdf](http://www1.eere.energy.gov/biomass/pdfs/mypp_april_2011.pdf)
- IEA (2009), Transport, Energy, and CO2: Moving Toward Sustainability. IEA/OECD.
- NAS (2011), Renewable Fuel Standard: Potential Economic and Environmental Effects of US Biofuel Policy. The National Academies Press, Washington, DC.
- UC Davis (2011). Parker, N., Tittmann, P., Jenkins, B., 2011. "National Biofuel Supply Analysis." UC Davis. Western Governors' Association as well as various studies including S. Yeh, N. Lutsey, and N. Parker, 2009, "Assessment of Technologies to Meet a Low Carbon Fuel Standard, *Environmental Science & Technology*, Vol 43, No. 18, 2009.
- US EPA [Environmental Protection Agency], 2010. "Renewable Fuel Standard Program (RFS2) Regulatory Impact Analysis," EPA -420-R-10-006, February.
- WSPA (2012). "Review of CARB Staff Analysis of "Illustrative" Low Carbon Fuel Standard (LCFS) Compliance Scenarios," prepared by Sierra Research, February 20, 2012
- CTA (2012). "The Impact of the Low Carbon Fuel Standard and Cap and Trade Programs on California Retail Diesel Prices," prepared by Stonebridge Associates, Inc ([www.stonebridge-associates.com](http://www.stonebridge-associates.com)). April 25, 2012.

- “Greenhouse gas emissions and global warming are among humanity’s most pressing concerns. Societal expectations on climate change are real, and our industry is expected to take a leadership role.”  
(Saudi Oil Minister, Jan 2012)